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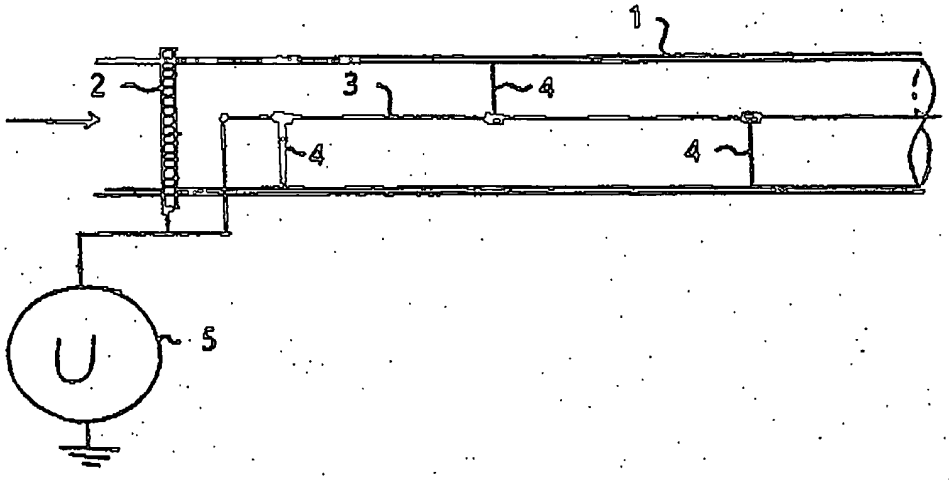
(54) Title: METHOD FOR REDUCING PRESSURE LOSS IN CONNECTION WITH TRANSPORT OF FLUID IN PIPES/DUCTS



(57) Abstract

A method is described for controlling pressure loss in connection with transportation of fluid in a pipeline (1) by controlling electrical charge concentration in fluid and/or pipeline. According to the invention the fluid is supplied with an electrical charge from at least one electrode (2, 3) arranged in the pipeline (1), at least the pipeline's (1) inner wall being made of a material which is capable of absorbing a charge from the fluid and retaining this charge, with the result that the amount of similar charges in the pipeline's (1) wall and the fluid is increased, thereby creating electrical repulsive forces between fluid and pipe wall. By this means the friction between pipe wall and fluid is reduced.

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method for reducing pressure loss in connection with transport of fluid in pipes/ducts

The present invention relates to a method for reducing pressure loss in a cost-effective, safe and energy-effective manner and thereby investment and operating costs in connection with transport of fluids in pipes/ducts.

A familiar and serious problem for all those who are involved in transporting fluids in pipes/ducts is that in many cases this transport is expensive and energy-demanding on account of pressure loss due to friction between the fluids and the pipe/duct. A method for cost-effectively reducing pressure loss in connection with pipe flows will therefore be of great value.

From US 4,254,800 it is known that it is possible to supply an electrical charge to a fluid which is transported in a pipe and subsequently expose the fluid to electrostatic or magnetic forces in order to regulate the through-flow of the fluid. In this publication, however, it is only described how this can be used to reduce the through-flow by the described apparatus acting as a valve at a given location in the pipe.

The task of the present invention is to provide a method for reducing the pressure drop in a pipeline where a fluid is transported over substantial distances and where the result of the pressure drop is that it is energy-demanding to pump the fluid through the pipeline. Thus a reduction in the pressure drop will lead to a corresponding reduction in the energy consumption during the fluid transport.

These objectives are achieved by employing the methods according to claim 1. The remaining claims describe advantageous embodiments of the method.

It is a well-known fact in physics that an important factor for determining which pressure level is necessary for maintaining fluid flow in pipes is the friction between fluid and pipe. It is further known from classic electrostatics that similar charges repel each other and dissimilar charges attract each other. According to classic fluid mechanics and electrostatics, therefore, the friction between fluid and pipe/duct and thereby the pressure which is required to maintain the flow will be dependent on net electrical charge in fluid and pipe/duct. Increased similar net charges in fluid and pipe/duct will reduce pressure loss since electrical repulsive forces near the pipe wall will

reduce the contact surface and thereby the friction between fluid and pipe/duct while increased dissimilar net charges will increase the pressure loss.

It has been found that the above-mentioned physical laws can be applied and that pressure loss in connection with pipe flow can be controlled by controlling the net charge in pipe/duct and fluid. According to the invention, therefore, the pressure loss can be reduced by increasing the amount of similar charges in pipe/duct and fluid, and the pressure loss increased by reducing the amount of similar charges in pipe/duct and fluid or increasing the amount of dissimilar charges. This requires the pipe wall to be made of an insulating material or at least one which is a poor conductor of electricity, such as teflon or another "flow coating" which is used for oil transport. The fluid moreover must be insulating or at least dielectric. In other words, the method can be used for hydrocarbons and gases, but not for water.

In a preferred embodiment of the invention the pipe/duct is formed from a material with adapted electrical conductivity properties, thus enabling the pipe/duct to retain a supplied net charge. The pipe/duct and/or fluid is then supplied with a net charge with the desired polarity by connecting it or them to a suitable power and/or voltage generator.

In a further preferred embodiment optimal pressure drop is achieved by controlling the space charge distribution in the fluid by extending a thin electrode (small contact surface) in the fluid flow's longitudinal direction, which electrode is coupled to the power and/or voltage generator.

The invention will now be described in further detail with reference to the attached drawings, in which

Fig. 1 is a schematic representation of the principle design of the invention,

Fig. 2 is an alternative design of an electrode for use in implementation of the method.

Figure 1 illustrates the principle construction of an embodiment of the method according to the invention. In a pipeline 1 in which fluid is transported the pipe wall, or at least the pipe wall's internal surface, is made of a material which is capable of absorbing and retaining electrical charges, but which is a poor conductor of electricity. Examples of such materials are

teflon and other "flow coating" which are employed in oil transportation. In order to supply the fluid with an electrical charge, an electrode grid 2 can be arranged across the direction of flow and/or a longitudinal electrode 3 can be provided which in this example is provided as a centre electrode in the pipeline. By means of these electrodes 2, 3 the fluid will absorb an electrical charge. For its part the fluid will emit a charge to the pipeline's 1 inner wall. On account of its poor electrical conductivity, and possibly also due to the fact that the pipeline is insulated from earth, the pipeline's inner wall will not emit a charge as quickly as it absorbs a charge before both fluid and pipeline are charged with charges with the same sign. In other words, electrical repulsive forces will be created between pipe wall and fluid, thus reducing the friction between fluid and the pipeline's inner wall.

The electrode grid 2 and the centre electrode 3 will preferably be made of a conducting or semi-conducting material of great durability. A suitable material for this purpose is stainless steel. It is necessary for the centre electrode 3 to be attached in such a manner that it remains substantially centred in the pipeline. This can be implemented by means of a stay 4 which preferably is electrically insulated from the centre electrode, and which in other respects is designed so as to offer the least possible flow resistance to the fluid. If there is an electrode grid 2 it should also be designed so that it does not offer any marked flow resistance to the fluid which is transported in the pipeline 1.

For supplying a charge to the fluid the electrodes 2, 3 are connected to one pole of a power or voltage source 5 whose other pole is connected to earth. In order to supply an adequate charge the voltage source should preferably have a voltage level of between 1kV and 150kV. In some cases it may also be appropriate to have even higher voltage levels. This will vary according to what kind of fluid is being transported in the pipeline 1, the diameter of the pipeline 1, the fluid's flow rate, the pipe wall's ability to absorb and retain a charge, etc., and must be adapted in each individual case. The voltage which is supplied to the electrodes will preferably be direct voltage, but it may also be appropriate to use voltage pulses. Any overlaying of a direct voltage with voltage pulses (ripples) will be able to influence the fluid's ionic properties, thus giving the system improved efficiency with lower voltages. Again the choice of voltage levels as well as pulse duration and frequency will depend on the characteristics of the different remaining parts of the system, such as

for example fluid and pipeline, and a person skilled in the art must select those values which are most effective in each individual case.

Figure 2 illustrates a detail of a system corresponding to that in figure 1, but where the longitudinal electrode 3 is in the form of a spiral which is arranged at a relatively short distance from the pipeline's 1 inner wall. In this embodiment a charge will be emitted to the fluid at a short distance from the pipe wall, and the transport of the charge from the fluid to the pipe wall will be more effective. Furthermore, the ion flow will generate some heat, leading to a certain increase in temperature in the fluid, which will have a positive effect on the fluid's viscosity. In a possible embodiment of the method according to the invention the electrode's electrical resistance and/or the power/voltage level from the power supply 5 will be chosen so as to create further heating. Again it will be dependent on external circumstances, such as for example the fluid's characteristics, whether consumption of energy for such heating provides a net energy gain when transporting fluid through the pipeline. This in turn will be a question of technical adaptations of the method in order to obtain the most efficient system possible.

PATENT CLAIMS

1. A method for controlling pressure loss in connection with fluid flow in pipelines,
characterized in that the charge concentration in the pipeline (1) and the fluid is controlled by providing at least one electrode (2, 3) in the pipeline (1) and that a voltage is applied to this at least one electrode (2, 3) with the result that when the fluid passes this at least one electrode (2, 3) the electrical charge is emitted to the fluid, the fluid further emitting the charge to the pipe wall, thus increasing the amount of similar charges in the pipeline's (1) wall and the fluid.

2. A method according to claim 1,
characterized in that at least the pipeline's (1) inner wall is made of a material with adapted electrical conductivity characteristics, thus enabling it to absorb and retain the supplied net charge.

3. A method according to claim 2,
characterized in that the said material is teflon.

4. A method according to one of the preceding claims,
characterized in that the voltage which is applied to the at least one electrode is at least 1kV.

5. A method according to one of the preceding claims,
characterized in that the voltage which is applied to the at least one electrode is in the range 1kV to 150kV.

6. A method according to one of the preceding claims,
characterized in that as the at least one electrode (2, 3) an electrode grid (2) is employed which is arranged across the fluid's direction of flow.

7. A method according to one of the preceding claims,
characterized in that as the at least one electrode (2, 3) an electrode (3) is employed which is arranged in the pipeline's (1) longitudinal direction.

8. A method according to claim 7,
characterized in that the electrode (3) arranged in the pipeline's (1)

longitudinal direction is a centre electrode with a small diameter and arranged along the pipeline's (1) centre axis (figure 1).

9. A method according to claim 7, characterized in that the electrode (3) arranged in the pipeline's (1) longitudinal direction is in the form of a spiral which is disposed at a short distance from the pipeline's (1) inner wall.

10. A method according to one of the preceding claims, characterized in that the at least one electrode's (2, 3) electrical characteristics and power/voltage level which are applied thereto are so selected that sufficient heat is emitted from the at least one electrode (2, 3) to increase the temperature of the fluid, thereby changing its viscosity.

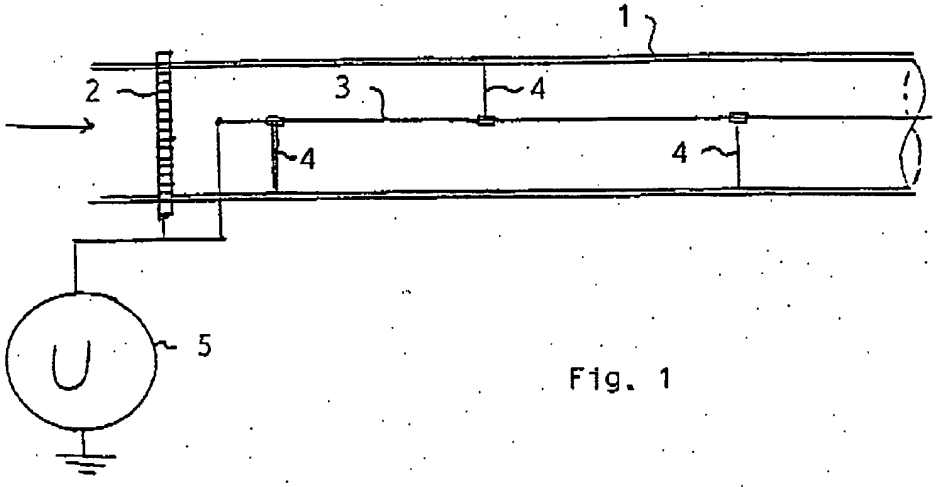

Fig. 1

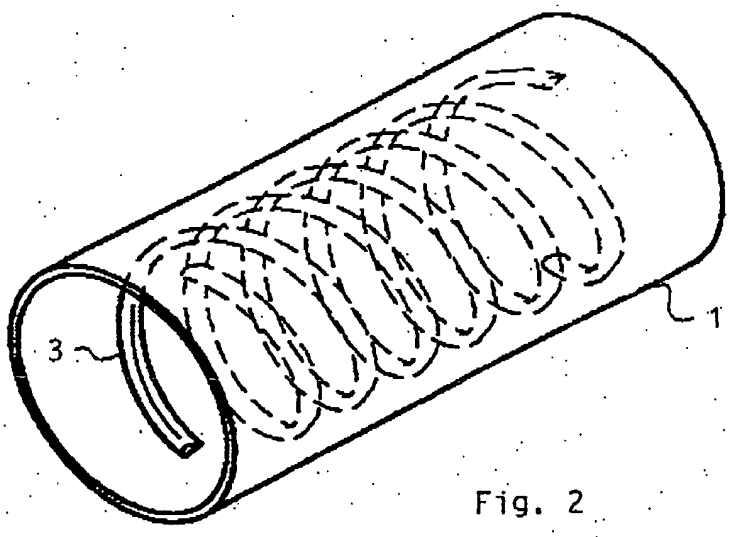

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 99/00142

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F15C 1/04, F17D 1/16, G05D 7/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F15C, G05D, F17D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4254800 A (KENJI MASAKI), 10 March 1981 (10.03.81), column 3, line 12 - line 35 --	1-7
X	GB 1385551 A (LENINGRADSKY ORDENA LENINA POLITEKHNICHESKY INSTITUT IMENI M.I. KALININA), 26 February 1975 (26.02.75), claims 1-4 --	1,7
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A	DE 3233838 A1 (WSW PLANUNGSGESELLSCHAFT MBH), 15 March 1984 (15.03.84), abstract --	1,3

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P	WO 9919260 A1 (WASKAAS, MAGNE), 22 April 1999 (22.04.99), abstract	1

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Information on patent family members

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